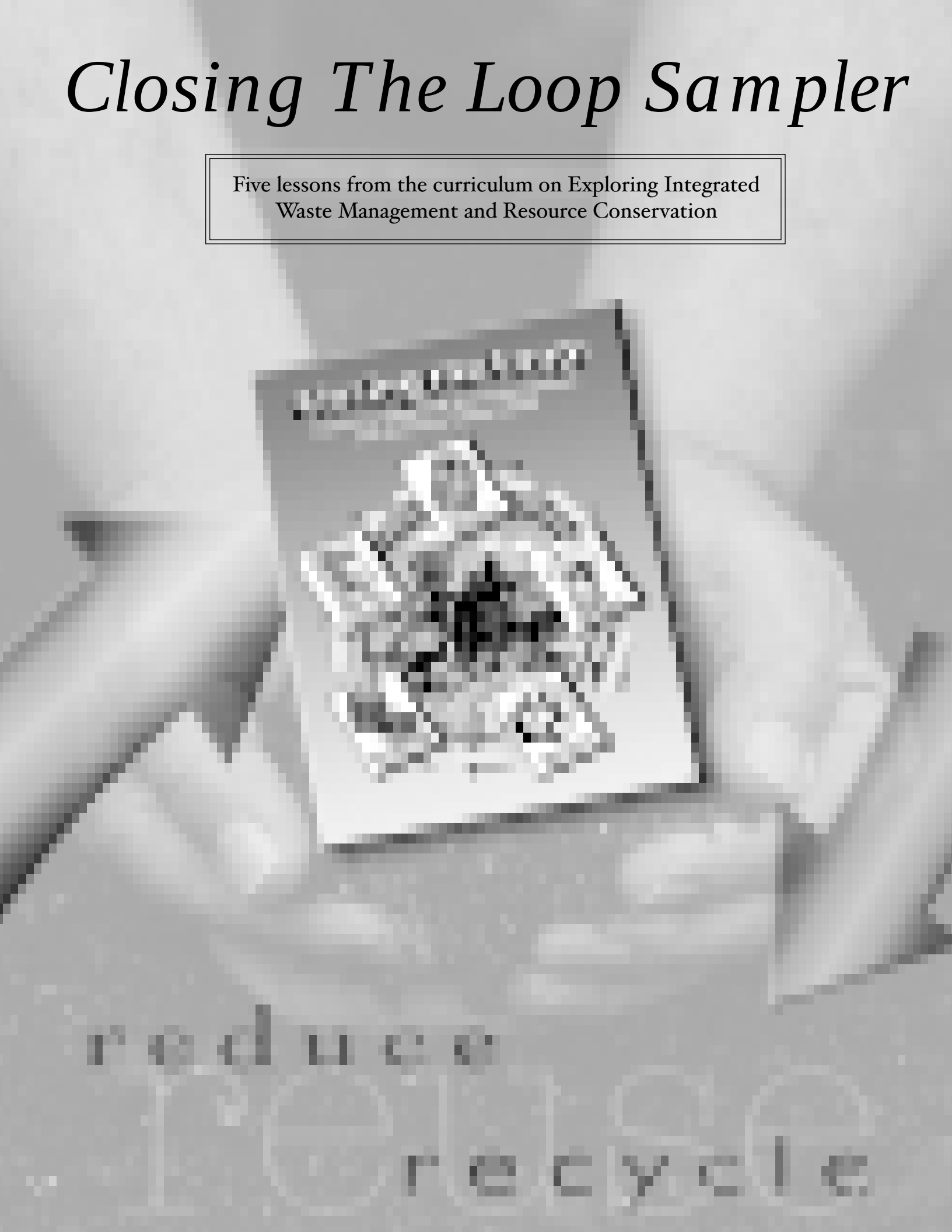
Closing The Loop Sampler

Five lessons from the curriculum on Exploring Integrated Waste Management and Resource Conservation



Dear Educators and Local Government Representatives

The California Integrated Waste Management Board and the California Department of Education are offering a sample of our highly acclaimed integrated waste management curriculum called *Closing the Loop: Exploring Integrated Waste Management and Resource Conservation*. This is a K–6 grade curriculum that was chosen by California environmental educators who evaluated a wide collection of integrated waste management materials using California education standards and frameworks.

The Board's first edition of *Closing the Loop* was originally published by an environmental education organization in Ohio. CIWMB obtained permission to customize *Closing the Loop* as a K–12 curriculum for California. Most recently, the 2000 edition has been rewritten into two modules that target K–3 and 4–6 grade levels. It was again field-tested by California schools and revisions were made before it was finalized and printed.

This free sample includes five of the lessons that you will find in the complete curriculum. These lessons, like all others in *Closing the Loop*, are hands-on and interdisciplinary and provide instruction on a broad spectrum of integrated waste management concepts. This sampler includes...

From Module K–3:

"What are Natural Resources?"

"Making Recycled Paper by Hand"

"The Basics of Vermicomposting"

And From Module 4–6:

"Away to the Landfill"

"Packaging—What a Waste!"

Give these lessons a try. If you are interested in receiving a full *Closing the Loop* curriculum to incorporate into your classroom teaching strategies, contact the Integrated Waste Management Board to schedule a workshop. Workshops are provided free of charge and all participants are given a complimentary copy of the complete curriculum. These workshops are interactive and engage teachers in hands-on activities. Workshops can be coordinated through teacher in-services, district training programs, or education association conferences.

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web site at www.ciwmb.ca.gov.

We're waiting to hear from you!

Here is our contact information

California Integrated Waste Management Board

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(916) 341-6769

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Table of Contents

Note: No appendices are included in this *Sampler.* You may access the complete appendix via our Web site at www.ciwmb.ca.gov / Schools / Curriculum / CTL / default.htm. For an overview of the appendix, turn to the last page.

Introduction to *Closing the Loop:*
Exploring Integrated Waste Management and Resource Conservation
Kindergarten Through Grade Six
A Conceptual Approach with Project-Based Learning

The *Closing the Loop* (*CTL*) curriculum is designed to introduce students to integrated waste management through awareness, understanding, and action, and to encourage students to address today's solid waste problems. The lessons focus on becoming aware of natural resources and understanding alternatives to burying waste through reducing, reusing, and recycling, therby conserving natural resources and extending the life of landfills.

By using *CTL*, teachers will be following recommendations from California's newly adopted content standards and curricular frameworks in a conceptual, interdisciplinary, and hands-on manner. Through specific projects, students apply what they have learned in the classroom and learn to follow certain practices in integrated waste management. Some project-based lessons are service-learning oriented, and in these lessons students participate in improving the environment in their school and community and have opportunities to educate others about what they have learned.

In spring 1996, the staff at the California Integrated Waste Management Board (CIWMB) Public Education Assistance Section decided to revise and update the existing *Closing the Loop* curriculum. The copyright for *Closing the Loop* was acquired by the CIWMB. The project director for the 2000 edition of *Closing the Loop* was Tricia Broddrick, and the project manager was Cara Morgan. Olga Clymire, an environmental education curriculum writer with the Lake County Office of education, was hired to make the revisions. Leslie Comnes, Education Writing Consultant, and Amber Robinson-Burmester, Integrated Waste Management Specialist, updated the Appendix. In 1998 Amber Robinson-Burmester took over the duties as project manager.

The main goals for those preparing the 2000 edition of *Closing the Loop* were to revise the original *CTL* lessons to make them more applicable to California's content standards and curricular frameworks; provide additional lessons in integrated waste management, especially for teachers of kindergarten through grade three; develop concepts (main ideas) for each lesson; select children's literature and reference books and videos to support the *CTL* lessons; and include suggestions for project-based learning. These goals were determined by a group of educators, which included teachers and representatives from the California Integrated Waste Management Board and the California Department of Education. This group also recommended separating the old *Closing the Loop* lessons into two modules: one for teachers of kindergarten through grade three and one for those teaching grades four through six.

Later, it was recommended that the following elements of an effective environmental education program be incorporated in the *CTL* units:

- Using thematic instruction
- Providing opportunities toeach lessons in built and natural settings
- Involving students in lifelong learning about local and global issues
- Engaging in ecologically responsible action projects
- Challenging students to use higher order thinking processes in the context of community issues
- Using hands-on and minds-on activities in classroom and field investigations

Forty-nine teachers throughout California fieldtested the lessons in the revised version of *Closing the Loop*. The goals of this field test were to:

- Verify that the revised *Closing the Loop* lessons provide an enjoyable and successful learning experience for students.
- Make the lessons more applicable to the content and pedagogy recommended in the content standards and frameworks adopted by the California State Board of Education.

- Identify changes and corrections that need to be made to make the curriculum effective for classroom use.

Teachers who field-tested the new *Closing the Loop* said that the lessons were easy to implement and that their students thoroughly enjoyed participating in the hands-on activities. They especially liked the project-based lessons and the journal writing. Although some lessons require a fair amount of preparation, most materials can be reused in future lessons, making the preparation time for those lessons shorter. Recommendations by field testers and examples of students' work from the field testers were incorporated in the revised lessons. In addition, Bill Andrew, Director of the Office of Environmental Education in the California Department of Education (CDE), and Gary Smith, coordinator of several CDE environmental education projects, who was on leave from the Anaheim Joint Unified School District, reviewed these lessons. Also, over a dozen professionals in the integrated waste management field checked the "Background Information for the Teacher" and the "Appendixes" for technical accuracy.

Natasha Stillman for San Francisco's Solid Waste Management Program has reviewed the units and developed a solid waste jurisdiction-oriented information packet. This packet includes local information about the closest landfills; locations of recycling centers; available speakers; field trip opportunities; and classes, books, and videos available to teachers living in the San Francisco area. It is recommended that teachers contact staff from their local solid waste management agencies and encourage them to develop packets of information concerning integrated waste management in their communities. A template in "Appendix G" has been designed to help guide the teacher to acquire information about local integrated waste management coordinators, facilities, and practices. For a copy of San Francisco's Solid Waste Management Program information packet, contact Natasha Stillman, School Education Coordinator, at (415) 554-3422; or the California Integrated Waste Management Board's Office of Integrated Environmental Education at (916) 341-6769.

The staff at the California Integrated Waste Management Board's Office of Integrated Environmental Education is planning to provide staff development opportunities for teachers. For information, call (916) 341-6769.

It would be beneficial to those who use this curriculum if the staff at the California Integrated Waste Management Board were kept informed of teachers' experiences with the lessons. Any descriptions and photographs of projects that students complete and that are sent to CIWMB's Office of Integrated Environmental Education would be considered for the next edition of *Closing the Loop*.

<u>The address is:</u>

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K–3 Module

Introduction to the K-3 Module of *Closing the Loop: Exploring Integrated Waste Management and Resource Conservation*

The lessons in *Closing the Loop: Exploring Integrated Waste Management and Resource Conservation* encourage students to be positive role models by examining their waste management habits and by voluntarily participating in projects that improve their school and community. The lessons in *Closing the Loop* (*CTL*) create a laboratory of learning. Students learn concepts and explore issues concerning natural resources and integrated waste management and apply the concepts tohe world outside their school.

This unit was rated "number one" by a committee of teachers who evaluated nearly 100 curricular and activity guides for the 1999 edition of *Environmental Education Compendium for Integrated Waste Management and Used Oil*.

The K-3 Module of the 2000 edition of *Closing the Loop* is composed of five units. A tab on the right-hand side of each right-facing page identifies the module and unit number. Each of the first four units contains five lessons, and Unit 5 is made up of three lessons. The titles of the units are:

- Unit 1: Conserving Natural Resources
- Unit 2: Reducing, Reusing, and Recycling Classroom Waste
- Unit 3: Vermicomposting
- Unit 4: Proper Disposal of Waste
- Unit 5: Proper Management of Household Hazardous Waste

The overview of each unit contains the following components:

- The unit's concept(s)
- Each lesson's title, concept(s), and overview
- A book or a list of books required to implement each unit (and sometimes additional books recommended for the unit)
- Projects that students can do and examples of classes participating in specific projects

By using *CTL*, teachers will be following recommendations from California's newly adopted content standards and from curricular frameworks in a conceptual, interdisciplinary, and hands-on manner. If a teacher wishes to replace an activity described in *CTL* with another activity from another curricular guide, this can be done easily. However, it is important that the main concept of each lesson be preserved, or the lesson will no longer fulfill the intent of its original design.

The California State Board of Education's content standards from the following documents were used in the *CTL* lessons:

- *Science Content Standards, Grades K-12*, Pre-publication Version, August 26, 1999
- *English-Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve.* Sacramento: California Department of Education, 1998
- *Mathematics Content Standards for California Public Schools, Kindergarten Through Grade Twelve.* Sacramento: California Department of Education, 1999

Note that only a prepublication version of the Science Content Standards was available at the time that this curriculum was written. However, all cited science content standards have been adopted by the California State Board of Education.

The following state frameworks are also cited in the *CTL* lessons:

- *Science Framework for California Public Schools, Kindergarten Through Grade Twelve*, 1990
- *History-Social Science Framework for California Public Schools, Kindergarten Through Grade Twelve*, 1988
- *The Visual and Performing Arts Framework for California Public Schools, Kindergarten Through Grade Twelve*, 1996

It is recommended that Unit 1 on natural resources be taught first, so students can get background information on natural resources and why they are important and so that students can understand the connection between integrated waste management and the conservation of natural resources. This unit sets the stage for understanding why reducing, reusing, and recycling are so important.

Ideally, the five units in the K-3 Module should be taught in the order presented. Within the units, the lessons should also be taught in the order presented. However, it is understood that some teachers prefer to select lessons to incorporate in their curriculum; therefore, an attempt was made to make each lesson stand on its own (although sometimes connections to other lessons are suggested).

Each lesson provides step-by-step instructions on how to implement the activities in the lesson. More experienced teachers may choose not to follow this lengthier explanation of the activities. Instead, they can use the overview of each unit as an outline of what they will have their students do in each lesson. They might wish to develop their own activities with the lesson's concepts in mind. As needed, they can review the instructions specified in the lessons and use parts of these instructions when developing their own instructional strategies.

In the K-3 Module, it has been suggested that certain activities be conducted with children in kindergarten and first grade, while other activities will be more appropriate for older students in grades two and three. The teacher can best judge which activities will provide the most meaningful experiences for his or her students.

Whenever possible, the authors recommended that reused materials be used in the lessons. It is also important for teachers to model reducing, reusing, and recycling classroom materials, including buying products made from recycled materials. In most lessons, when teachers develop a list with their students, they have the option of writing the list on a chalkboard or on butcher paper. However, if a list needs to be kept and used again in future lessons, the butcher paper provides a more permanent alternative and eliminates the possibility that the contents will be erased. It is recommended that both sides of the butcher paper be used for writing, and then the paper can be used in art projects, composted (or vermicomposted), or recycled.

It is highly recommended that the teacher encourage students to participate in a variety of projects. A project is a task or problem that usually groups of students work on to supplement and apply what they have learned in the classroom. Allow students to plan and design their projects.

In this curriculum students have opportunities to engage in many different types of projects. Some projects are relatively simple, such as making note cards out of recycled paper to give as gifts or decorating cardboard boxes for gathering items that can be reused in the classroom and for those that can be recycled. Other projects are much more involved, such as maintaining a vermicomposting bin in the classroom or presenting a play to other classes about the importance of natural resources. And still others will take large amounts of time and dedication, such as planting seedlings, shrubs, and wildflowers on the school campus or in a nearby park or participating in a coastal cleanup of litter.

Examples of projects and classes participating in some of the projects are listed in the "Overview" for each unit. For more information on project-based learning, see "Tips for Implementing Projects." Also, the Autodesk Foundation provides information for educators interested in project-based learning. The Foundation's website is http://www.autodesk.com/foundation.

Make public what your class is doing when implementing *Closing the Loop* and publicize some of its recommended projects. Have students design presentation panels, submit photographs and news articles to local newspapers, tape conversations with students about their projects, videotape brainstorming sessions, and show students' work during the school's open house.

LESSON 1: What Are Natural Resources?

LESSON'S CONCEPT

Natural resources are things that come from nature, such as plants, animals, soil, minerals, energy sources (e.g., sunlight, fossil fuels), air, and water. These natural resources are used to meet the needs of all living things, including people.

PURPOSE

Students will learn about natural resources and the products people make from these resources. Students also prepare for the unit by making journals.

OVERVIEW

In this lesson students will:

• Make journals.

• Observe models of categories of natural resources.

• Identify natural resources on the school grounds, record them on a chart, and describe them in their journals.

• Determine natural resources used to make various items on the school grounds and in the classroom.

• Compare items made from different natural resources.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS

• Students work together to identify the natural resources used to make objects outside and inside the classroom.

- "Properties of materials can be observed, measured, and predicted. As a basis for understanding this concept, students know: objects can be described in terms of the materials they are made of and their physical properties." (*Science Content Standards, Grades K–12*; Kindergarten; Physical Science, Standard 1a)

- "Humans use air, fresh water, soil, minerals, fossil fuels, and other sources of energy that comes from the Earth. " (*Science Framework*, page 97)

- "Students collect information about objects and events in their environment." (*The California Mathematics Academic Content Standards for Grades K–12*; Kindergarten; Statistics, Data Analysis and Probability, Standard 1)

- "To participate effectively in society, students need to: Develop personal skills. . . group interaction skills (and). . . social and political participation skills." (*History–Social Science Framework*, page 24)

• Students describe in their journals some natural resources outside and inside of the classroom and determine the natural resources used to make certain products. ("Using the Grade 1 writing strategies outlined in the previous standard, students write brief descriptions of a real object, person, place, or event using sensory details." *California Language Arts: Reading, Writing, Listening, and Speaking Content Standards for Grades K–12*; Grade 1; Writing Applications, Standard 2.2)

SCIENTIFIC THINKING PROCESSES:

observing, communicating, comparing, classifying

TIME:

45–60 minutes to prepare for the lesson; 60 minutes to implement the lesson

VOCABULARY:

crude oil, fossil fuels, icon, minerals, natural resources, organisms

PREPARATION

___**1.** Read the "Background Information for the Teacher" at the end of this lesson.

___**2.** Obtain used paper (blank on one side) for students to use for journals. (Sources of used paper include printers, real estate offices, school's office or classrooms, and parents.)

___**3.** Start collecting "clean" classroom trash to use for Lesson 3 (nothing toxic or potentially dangerous; no food that can get spoiled). Keep it in a box or bag. Make sure to notify the custodian of your plan. Try to include paper towels, candy wrappers, short pencils, small pieces of chalk, bent paper clips, paper used on one side and used on both sides, aluminum can or tray, plastic container, milk carton, polystyrene meat tray, dried-up markers and glue sticks, nuts with hard shells, and fresh orange peels.

___**4.** Make a copy of the "Natural Resources Chart" for each pair of students. (page L1–8-x)

MATERIALS

___ Items that can represent different categories of natural resources:

- ___Potted plant (to represent trees and other plants)
- ___Stuffed animal (to represent animals)
- ___Bag of soil (to represent soil)
- ___Rock (to represent minerals)
- ___Molasses or chocolate syrup (to represent crude oil, a fossil fuel which is an energy source)
- ___Empty jar and a jar full of water (to represent air and water)

___ A pocket folder for each student (If you plan to have students make their own journals, see "One Way to Make Your Own Journal" in this lesson.)

___ A copy of the "Natural Resources Chart" for each pair of students

___ Clipboard (Heavy cardboard cut to 9" x 12" can be used as a clipboard, and a large paper clip can keep the paper on the cardboard.)

___ A file folder for each student for the "Assess ment Portfolio" (If possible, use reused ones or those made from recycled materials.)

___ Optional: a file box to keep the "Assessment Portfolios"

PRE-ACTIVITY QUESTIONS

A. Tell students that they will each make a journal. In the journal they will write and draw information about what they are study ing. Students should know that people write and draw in journals to record observations, thoughts, ideas, and information about certain topics.

B. Provide a pocket folder and ten sheets of paper to each student. (If you do not have access to pocket folders, students can make their own folders by following the directions on "One Way to Make Your Own Journal.") To model conserving paper, distribute paper that was used on one side.

C. Ask students to draw or describe in their journals something that comes from nature.

D. Ask students to share the entries from their journals as you write their responses on the chalkboard.

E. Ask students what they know about the word *natural* and the word *resources*. Encourage them to create a class definition of *natural resources.*

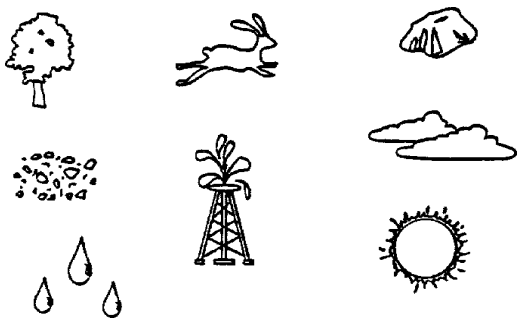
PROCEDURE

A. Show the following items, each representing a category of natural resources: potted plant, stuffed animal, soil, rock, and molasses (to represent crude oil, an energy source).

- Tell students that things that come from nature are called *natural resources.* Natural resources are things that all living things need in order to live.

- Help students identify each category of natural resources as you list them on the chalkboard: plants, animals, soil, minerals (rocks), energy sources (sunlight; fossil fuels, such as crude oil).
- Ask students what else they can't live without. Lead them to say "water" and "air."

B. Ask students to draw an icon for each of the seven categories of natural resources. (Note: Help them write a definition for icon and include it in their journals.) This can be done in groups of seven, with each student drawing one icon and writing the category that the icon represents. (See the example below for ideas for icons.)



C. Provide a copy of the "Natural Resources Chart" for each pair of students. Note that students will focus on five categories of natural resources, because these are the ones most often used by people to make things (in addition to air and water, which we usually use in the manufacturing process of products): plants, animals, soil, minerals, and crude oil (from fossil fuels in the category of energy sources).

- Describe how to complete the chart. Students should write or draw what they see that comes from the natural resources listed on their charts.
- In preparation for a trip outside the classroom, ask each pair of students to bring a "Natural Resources Chart," pencil, and a clipboard. (A clipboard can be made out of stiff cardboard.)
- Lead students outside.

Note: The answers in *italics* are possible students' answers and might not reflect a correct answer.

- Help students identify things that are part of nature. *Trees, rocks, soil.*
- Ask them what natural resources they see (or feel, in the case of air). *Plants, animals (people), minerals, crude oil (asphalt), air*
- Ask students what they see that people have made from natural resources. For example, "What do you see that is made from a plant?" *A wooden bench is made from wood from a plant.* "What do you see that is made from minerals, such as rocks and steel?" *The building, the road, the poles supporting the swing.*
- Select one item on the school grounds and help students complete their charts.
- Lead students on a walk on the school grounds to look for natural resources and help them to complete their charts.

D. Back in the classroom, ask students to write or draw the following in their journals:

1. I saw _____
2. _____ is part of nature.
3. One thing that I saw that was made by people is _____
4. The natural resource or resources from which this thing was made is _____

E. Ask students to share their journal entries. Then discuss some ways that natural resources are used by people.

DISCUSSION/QUESTIONS

A. Have students locate in the classroom objects made from natural resources. Ask students from which category of natural resources this object was made.

B. Ask students to review their original class definition of natural resources and ask whether they wish to change any of the words to make the meaning more clear and accurate.

C. Discuss with students:

- Which items that were seen indoors and outdoors were different but came from the same natural resource? *Buildings and the sidewalk; desks and bench*
- Which items that were seen indoors and outdoors were similar but came from different natural resources? *Wooden bench and plastic bench*

Note: In Lesson 2, students will learn more about ways people use natural resources.

APPLICATION

A. As a class, make a drawing (mural) linking an item in the classroom to the natural resource that was used to make this item; e.g., wooden chair—plant.

B. Ask students to draw or write in their journals what they learned about natural resources.

C. Ask students to share their journal entries.

Homework Assignment: Ask students to select an item at home and to be prepared to tell the class the following day what the item is and what natural resource or resources it came from.

D. Ask students to share their homework assignment.

E. In addition to journals, it is recommended that students make an "Assessment Portfolio" to keep samples of their work from each lesson or unit. This will provide an authentic assessment of performance-based student work.

1. Introduce the idea of a portfolio. Explain that a portfolio contains information that illustrates a student's work. Discuss the following reasons for a student to select items to be placed in a portfolio:

- It is the student's best work during the lesson or unit.
- It represents something that the student learned.
- It represents something that was chal lenging to the student.
- It is something that took a long time and effort to complete.
- It was something the student greatly improved upon. (The student could submit "before" and "after" examples of work.)

2. Provide a file folder to each student.

- Ask each student to write his or her name on the tab of the file folder. (You might need to help the younger students with this task.)
- Ask students to select products (drawings or writings) from their journals.
- Have students answer the following questions verbally about the work they selected (could be shared with the class if the students agree to do so):
  - Why did you choose this piece to include in your portfolio?
  - Why is this your best work (drawing, writing, project)?
  - What did you learn from this work?
  - If you ever did this project (or other work) again, what would you do differently?

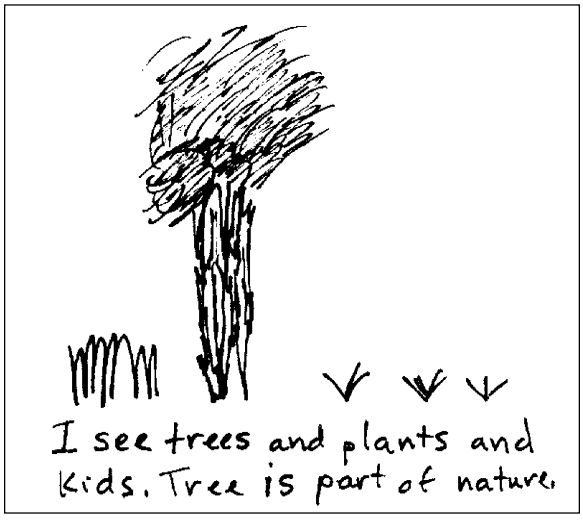
Note: It is recommended that a file box be provided to keep the students' "Assessment Portfolios."

Note: Students can select examples of work from their journals and from any projects that they completed at the end of each lesson. Or, instead of selecting a product from each lesson, students can select one or two from the entire unit, once the unit has been completed.

EXTENSION

Make a class list of things in the room according to the natural resources from which they were made. Graph things in the room by categories of natural resources. Discuss:

- What is the most common natural resource used in the classroom?
- Why is it the most common natural resource used?



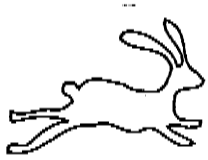
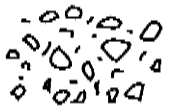
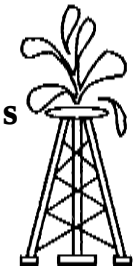
Submitted by Beth O'Neal, kindergarten and first-grade teacher, Marguerite Hahn Elementary School, Cotati–Rohnert Park Unified School District.

Submitted by Debby Carter, kindergarten and first-grade teacher, Coyote Valley Elementary School, Middletown Unified School District.

Student's Page

Natural Resources Chart

Names: _____ **Date:** _____

Natural resource	Object made by people
Plants 	
Animals 	
Soil 	
Minerals 	
Energy sources (fossil fuels, like crude oil) 	

ONE WAY TO MAKE YOUR OWN JOURNAL

SUPPLIES NEEDED

___ 12" X 18" tagboard or construction paper (two sheets for each student)

___ Stapler

___ Three-hole paper punch and brass fasteners (three for each student). If these are not available, the pages can be stapled.

___ Lined and unlined paper (15 sheets per student: 5 lined and 10 unlined)To model reusing, use paper that has been used on one side.

DIRECTIONS

1. Distribute two sheets of 12" X 18" tagboard or construction paper to each student.

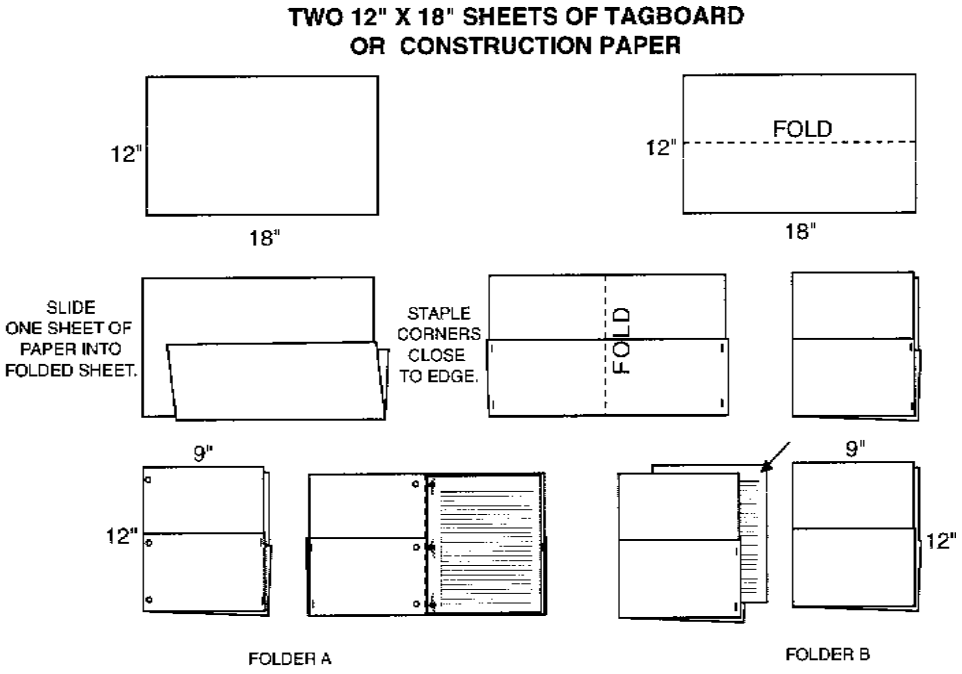
2. Have students make their journals by doing the following (see illustrations below):

- Fold one sheet of tagboard or construction paper in half lengthwise.
- Slide one sheet of paper into the folded sheet.
- With the folder open, staple the left side and the right side of the folded sheet onto the unfolded sheet, as close to the edge as possible. The folded sheet will make pockets on the inside and outside of the front cover.
- Fold the entire journal cover in half so it closes like a book.

3. **A.** If you have brass brads, punch three holes in the left margin with a three-hole punch. (See Folder A.) Place the brass fasteners through the back of the folder and through the lined and unlined pages but not through the front cover. This will make the front cover easier to open.

B. If you do not have brass brads, staple the journal pages to the journal cover.

(See Folder B.)



BACKGROUND INFORMATION FOR THE TEACHER

Natural resources are things that come from nature (the natural environment) and are the living and nonliving components that support life on Earth. They can be classified into seven categories: plants, animals, soil, minerals, energy sources (e.g., sunlight, fossil fuels), air, and water.

All products that we use everyday come from Earth's natural resources, which provide the raw material for the products that people make. For example, iron ore is the raw material in the natural resources category, mineral, and people use iron ore to make steel. Steel is used to make cars, appliances, and many other products. Trees are natural resources classified as plants, and people use trees for lumber to build houses and other structures; they also use a tree's pulp to make paper.

This unit introduces students to different categories of natural resources and ways some natural resources are used by people to make a variety of products (which often end up in a landfill). Since natural resources are required by all living things, humans are also totally dependent on natural resources, such as air, water, plants, and animals, for their survival.

In this unit, natural resources are classified into seven categories, which are briefly described below. The category of energy sources can be further subdivided into sunlight, fossil fuels, and other energy sources (e.g., wind, hydropower). Ways that people depend on these categories of natural resources are further described in Lesson 2.

PLANTS—Plants are living things that can produce their own food. Trees, shrubs, grasses, seaweed, and some microscopic algae are examples of plants. Green plants produce oxygen. They also produce food for animals that eat plants.

ANIMALS—Most animals can be defined as living things that rely on other organisms for food. Animals have a nervous system and can usually move on their own. Examples of types of animals are: mammals (includes humans), birds, reptiles, amphibians, fish, and invertebrates, such as insects, spiders, and worms. Some microscopic living things are also classified as animals.

SOIL—Soil is a mixture of minerals from weathered rock and decaying plant and animal matter. It also consists of microscopic living things, such as bacteria and fungi. Most plants that live on land need soil in which to grow, and soil provides water and nutrients to plants. Many animals live on or in soil.

MINERALS—Minerals are naturally occurring substances that originally came from rock, such as phosphorous, bauxite, iron, salt, gold, silver, copper, and potassium. Many minerals are essential for the healthy growth of plants and animals, and plants absorb minerals that are dissolved in water. Animals must obtain needed minerals by eating plants or by eating other animals that have eaten plants

AIR—Animals need oxygen in air to breathe, and plants use carbon dioxide in air in the process of photosynthesis. The gases are recycled through plants and animals.

WATER—Plants use water when manufacturing their food, and animals drink or absorb water to maintain bodily functions. Some animals live in water, and some use it as a place from which to get food, to seek protection, or to cool off. Fresh water on land is replenished by the water cycle and is essential to all living things.

ENERGY SOURCES

• **Sunlight**—The energy derived from sunlight is used by green plants for photosynthesis. Sunlight also powers the water cycle by evaporating water from land and surface water. Note that "sunlight" is not addressed in this unit, because the lessons focus on the connections among natural resources, manufactured items, and solid waste.

• **Fossil Fuels**—Fossil fuels include crude oil, coal, and natural gas. The fossil fuels we are using now originated from partially decayed plants and animals that lived millions of years ago. In this unit students are introduced to crude oil. The crude oil that we are presently using came from marine plankton that lived millions of years ago. These marine plants died, and through time and tremendous pressure and heat created by layers of rock that trapped the plants, crude oil was formed.

- **Other Energy Sources**—Other energy sources include wind, hydropower, geothermal, and tidal energy. These are not addressed in *Closing the Loop*.

Note: For information and activities on renewable and nonrenewable natural resources, see 4–6 Module, Unit 1, Lesson 4.

At the Solar Community Housing Association, Homestead CO-OP, children look for examples of natural resources and objects that people made from natural resources.

NOTES